

WHAT IS CLAIMED IS:

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- 1 1. A method for improving optical interactance
2 measurements comprising the steps of:
3 providing illumination by way of a plurality of
4 different paths through a specimen having a characteristic to be
5 measured;
6 sensing a plurality of independent signals developed
7 at the same time or in rapid sequence representing optical
8 information from said specimen; and
9 processing said signals in accordance with appropriate
10 modeling techniques to minimize inaccuracies in spectroscopic
11 determination of qualitative or quantitative characteristics of
12 the specimen.

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1 *directing* 2. The method of claim 1, including the step of
2 *independent* providing the illumination of the specimen simultaneously along
3 said different paths.

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1 *directing* 3. The method of claim 1 including the step of
2 *independent* providing the illumination of the specimen sequentially along
3 said different paths.

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1 4. The method of claim 2 including the step of
2 providing the illumination of the specimen at different
3 frequencies along said different paths respectively.

1 5. The method of claim 2 including the step of
2 providing illumination of the specimen with different time
3 sequence codes along said different paths respectively.

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1 *sub G2* 6. The method of claim 1 including the step of
2 *illuminated surface of said material* providing the illumination at an angle with respect to the *optical*
3 *axis of the detection means.*

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1 7. Apparatus for improving optical interactance
2 measurements comprising:
3 means for providing illumination to a specimen having
4 a characteristic to be measured along a plurality of different
5 paths;

6 means for sensing optical information provided from an
7 illuminated specimen;

8 means for developing a plurality of independent
9 signals corresponding in number to said plurality of paths, said
10 signals representing said optical information obtained from said
11 specimen; and

12 means for processing said signals in accordance with
13 appropriate modeling techniques to minimize inaccuracies in
14 spectroscopic determination of quantitative or qualitative
15 characteristics of the specimen.

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2 8. The apparatus of claim 7 including means for
1 providing the illumination simultaneously along said paths.

2 9. The apparatus of claim 7 including means for
1 providing the illumination sequentially along said paths.

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1 10. The apparatus of claim 7 including means for
2 modulating said illumination provided to said paths so that each
3 path had a different modulating characteristic, said apparatus
4 also including means for demodulating said signals.

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1 11. Apparatus for improving optical interactance,
2 transmittance and reflectance measurements comprising:

3 an elongated probe having a body portion and a tip
4 portion, the body portion comprising a central tubular element
5 surrounded by an annular outer element;

6 the tip portion having a central aperture which
7 communicates with said central tubular element and at least one
8 ring which communicate with said annular outer element;

9 the ring or rings in said tip portion being angled
10 with respect to the longitudinal axis of the probe;

11 a number of fiber optic bundles whose number
12 corresponds to said plurality of rings being disposed within
13 said outer element, each bundle being arranged at one end to
14 exit at a respective ring and, at the other end, at least one
15 such bundle to be connected to a source of illumination; and

16 optical means disposed in the central tubular element
17 for receiving optical information from said central aperture

18 from a specimen and for conveying said information to a sensing
19 device so as to develop signals representing said specimen
20 optical information.

1 12. The apparatus of claim 11 wherein each fiber
2 optic bundle is arranged at the other end to be connected to a
3 source of illumination.

1 13. The apparatus of claim 11 also including means to
2 process said signals in accordance with appropriate modeling
3 techniques to minimize inaccuracies in spectroscopic
4 determination of qualitative or quantitative characteristics of
5 the specimen.

1 14. The apparatus of claim 11 wherein said tip
2 portion and fiber optic elements at the tip portion are angled
3 at approximately 26° with respect to the longitudinal axis of
4 the probe.

1 15. The apparatus of claim 11 including at least one
2 lens disposed in said central tubular element for focusing the
3 optical information received in said central aperture and means
4 responsive to the focused information for forming a signal
5 representing said information.

1 16. The apparatus of claim 15 wherein said means
2 responsive to the focused information includes a detector at the
3 focus of said lens, said detector providing an output signal
4 representing said information.

1 17. The apparatus of claim 15 wherein said means
2 responsive to the focused information includes a fiber optic
3 element for conveying the focused optical information to a
4 detector responsive to the optical information conveyed by the
5 fiber optic element.

1 18. The apparatus of claim 11 also including fiber
2 optic means for monitoring the energy received by the specimen.

1 19. The apparatus of claim 15 including means for
2 allowing the focusing of said lenses to be changed.

1 20. A method of using the apparatus of claim 7 or
2 claim 11 including the step of arranging the tip of the probe

3 adjacent a specimen of small size so that reflected energy from
4 said specimen is directed to said central aperture.

1 21. A method of using the apparatus of claim 7 or
2 claim 11 including the steps of arranging the tip of the probe
3 adjacent a specimen of small size and using fiber optic elements
4 to receive energy transmitted through said specimen to said
5 central aperture.

1 22. A method of using the apparatus of claim 7 or
2 claim 11 including the step of providing a further source of
3 illumination, arranging the tip of the probe adjacent a near
4 side of a specimen of small size, arranging the further source
5 of illumination on a far side of said specimen, using said probe
6 so that reflected energy from said specimen is directed to said
7 central aperture and/or energy transmitted by said further
8 source through said specimen is directed to said central
9 aperture.

A 1 23. A ^{in a} method as in claim 22 including the step of
2 selectively choosing an operational mode of reflectance,
3 transmittance or combined reflectance and transmittance.

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A8 1 24. A method of using the apparatus of claim 7 or
2 claim 11 including the steps of providing a further detector for
3 developing an electrical signal responsive to illumination,
4 arranging the top of the probe adjacent the near side of a
5 specimen of small size, arranging said further detector on a far
6 side of said specimen, using said probe so that reflected energy
7 from said specimen is directed to said central aperture and/or
8 energy transmittal by said probe is detected by said further
9 detector.

A 1 25. ^{in a} method as in claim 24 including the step of
2 selectively choosing an operational mode of reflectance,
3 ~~transmittance or combined reflectance and transmittance.~~

1 26. Apparatus for improving optical interactance,
2 transmittance and reflectance measurements comprising:

3 an elongated probe having a body portion and a tip
4 portion, the body portion comprising a central tubular element
5 surrounded by an annular outer element;

6 the tip portion having a central aperture which
7 communicates with said central tubular element and a plurality
8 of rings which communicate with said annular outer element;

9 the rings in said tip portion being angled with
10 respect to the longitudinal axis of the probe;

11 a plurality of the fiber optic bundles whose number
12 corresponds to said plurality of rings being disposed within
13 said outer element, at least one bundle being arranged at one
14 end to exit at a respective ring for receiving specimen
15 information and, at the other end, adapted to be connected to a
16 detector for developing a signal; and

17 said central tubular element being connected at one
18 end with a source of illumination, which illumination will exit
19 at the central aperture;

20 whereby independent signals ^{responsive to said illumination} representing said specimen
21 information may be developed.

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